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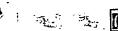
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Title

Rydroptaning Hydrofoil/Airfoil Structures and Amphibious and Aquatic Braft

Sigld of invention:

This invention celaics to hydroplaning hydrofolis, airfoil structures on Clying Wing structures, lightweight amphibious structures and squatic crafts and more particularly to bydropleming hydrofoil/akefoil structures that plane on or through a fluid preferably wither water or air which are optionally self-supporting or attached to aquatic structures or watercraft, particularly sailing craft.

15 Background:

Man continues to drown of going faster and faster. On water and through air, this is evidenced by the changing designs of fresh water and ocean racing watercraft and the stealth sircraft flying wings. Whatever the design, there is a continuing search for new hydrofoils, and aitfoil or flying wing structures which will achieve faster speeds on water and through air. U.S. Patent 4,635,577, granted to Palmquist on January 13, 1987, is an example of one attempt to provide a hydroplaning hydrofoll and air wing supported sailing craft.

Summary of the Invention

According to the present invention there is provided a hydroplaning hydrofoil and airfoil structure for planing on or through a fluid preferably sither water or air comprising in its broadest aspects for waver as exemplified in Figures 21-23: at least two foils each having an underside plane or substantially planar-bottom surface, two of said planar-bottom surfaces intersecting along a fore and aft longitudinal

















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'accelerates through to achieve either hydroplace or airfoi! support.

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however, variations may be readily apparent to those skilled in the art without detracting from the smallties of the structures and performances described in this invention. For example the hydroplanting hydrofoil/airfoil structure in its preferred and most preferred configurations offers additional performance options that include planting on or through a fluid such as water or air. Of course in an airfoil configuration such as an ultralight wing aircraft, glider wing or kite, the same shape hydroplanting hydrofoil/airfoil structure performs as an airfoil, wing structure or planar wing structure planting or flying through air begain described.

An will be evidenced from the title of this invention, a hydroplaning hydrotoil/airfoil structure for planing on or flying through a fluid is shown supporting itself in Figures 37 to 41. In describing these Figures, the same reference numerals for the same parts will be used as in Figures 4-6 for clarity and simplification.

riqure 37 is an enlarged side view, similar to the hydroplaning hydrofoil/airfoil structure 19 shown in Figures 4, 5, and 6 with fin 62 and strute 63-54 removed, showing an engine or electric motor 16 and air propeller 31 from Figure 1 mounted on stanchion 38 plus a topside air rudder 113 mounted along longitudinal temp foil centerline 15 as shown in Figure 40 and elevator or alloron 114 attachment to air rudder 113. This buoyant hydroplaning hydrofoil/airfoil structure 22 is shown hydroplaning at water level 51 prior to flight and in Figure 38 the hydroplaning bydrofoil/airfoil structure 32 or flying wing, planes or flies through air in sustained flight.





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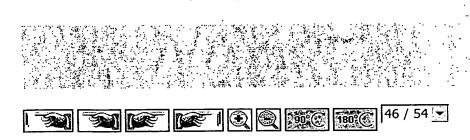
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rigure 39 is a front view and Figure 40 is a top view of the hydroplaning bydrofolt/sirfoil structure 32 shown in Figures 37 and 30 hydroplaning at water level 51 and is similar to the structure shown in Figures 4-6 beging the same reference numerals as shown in Figure 6 with Fin 62 and struts 52-51 removed.

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Figure 41 is a side view of the identical hydroplaning hydrofoll/airfoll structure 39 shown in Figures 4-6 gliding or planing through air. In this sigure, fin 67 is retained.

10 Figure, fin 52 is retained. As described for Pigures 4-6, the hydroplaning hydrofoil/airroil structure 39 in Piguros 39 and 40 has a left side foil top surface 43, and a right side foil top surface AR each having a fore fold top section (49 15 and 50 respectively) converging to form a full length Fore and aft longitudinal top foil centerline 25, and a buttom centerline 76 formed by two converging full length fall planar-bottom surfaces, a loft side foil planar-bottom surface 27 and a right side foil planarbottom surface 72. Foil planar-bottom sunfaces 11 and 78 ascend transversely from the longitudinal bottom centerline 16 to form a dihedral angle of about 18" as whomn or in the range of about 2° to 50° broadly on preferably also in the range of about 2° to 50° or most preferably in the range of about 2° to 30°, Each left side foil planar-bottom surface 22 and right side foil planar-hottom surface 18 has a fore foil planar-bottom section (79 and 80 respectively) which is a forward extension along the longitudinal bottom centerline .75. Each fore fell planar-bottom section has a swept-back leading edge of 60° as shown or one proferably ranging from about 30° to about 80° swept-back as described for Figures 22 and 26 or most preferably ranging from about. 45° to about 70° swept-back as described for Figures 27-



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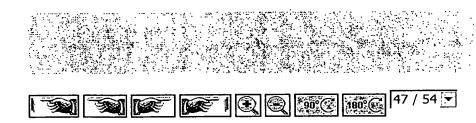
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The length of each fore toll planer-bottom section 72 and 40, as shown in Figure 40 is the same as described for Figures 5 and 6, and is about the first one-third of the entire length or chord of the hydroplaning hydrofoil/mirfoil structure along longitudinal top foil and bottom centerlines 75 and 75; however, the length of the Fore foil planer-bottom sections in their broadest aspects can range from 0° shown in Figure 23 or in the proferred length of about one fourth of the chord length shown in Figure 25 to about the first two-thirds to three-fourths of the chord length along top foil and bottom conterlines 25 and 16 shown in Figures 22 and 25.

Each left side foil planar-bottom surface 11 and right side foil planar-bottom surface 18 has an all foil planar-bottom section which is a backward or aft extension along the longitudinal bottom centerline 16. As shown in Figures 39 and 40, each aft foil planar-bottom section 68 and 69 at high speed water or fluid level 51 has a forward swept trailing edge 82 of 30° as shown or one preferably runging from about 0° to about 60° forward swept as described for Figures 22 and 24-26 or most preferably from about 10° to about 45° forward swept as described for Figures 27-29.

The length of each aft foil planar-bottom section fil and 62 is about the last one-fourth to about one-third of the entire chord length of the hydroplaning hydrofoil/airfoil structure along longitudinal bottom centerline Is at high speed water or fluid level Is as shown in Figure 39. The aft foil planar-bottom sections 58 and 62 vary in wetted surface area and length with speed and load; however, it is the section of the hydroplaning hydrofoil/airfoil structure which provides for high speed hydroplaning prior to sustained flight.





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The left side and right side foil planar-bottom surfaces IZ and Z8 have left wing and right wing forward swept leading edges R1 of 12° as shown in Figure 40; however, left and right leading edges R1 can be forward a swept preferably in the range of about 0° to about 60° forward sweep or described for Figures 22 and 24-26, or most proferably in the range of about 4° to about 45° forward sweep as described for Figures 27-29. Foll planar-bottom surfaces II and IB have forward swept 10 trailing edges coextensive with aft foll placer-bottom section trailing edge 82, i.e., forward swept 30° as shown, but with forward swept ranges as described above.

The angle of abtack may range from about 1° to 16° as described earlier for Figures 21-23 while

15 accelerating through water level 51 before becoming airborne in sustained flight. Once airborne, the angle of attack varies groutly depending on speed, payload, and whether the airfoil structure 39 is ascending or descending. Motor 36, air propoller 37, standhiou 38, topside air rudder 111 and elevator 114 are as described in Figure 37.

Optional holes 82 shown in Figure 40 accommodate optional step 25 as described more fully for the description of Figure 10 and as shown in Figures 14A, 25 15, 16B and 17. These optional holes will also accommodate removable or permanent fin 62 as shown in Figures 5 and 41 or a ruddex 22 as shown in Figures 7 and 8.

Optional power, winy stabilizers including winglets of and canards, landing wheels, and passenger or payload carrying enclosures may be built in or attached to various scale hydroplaning hydrofoil or mirfoil structures for gliding or propolled flight. In concluding the description of this invention, a light weight bydroplaning hydrofoil/mirfoil structure selected



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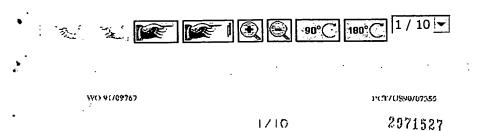
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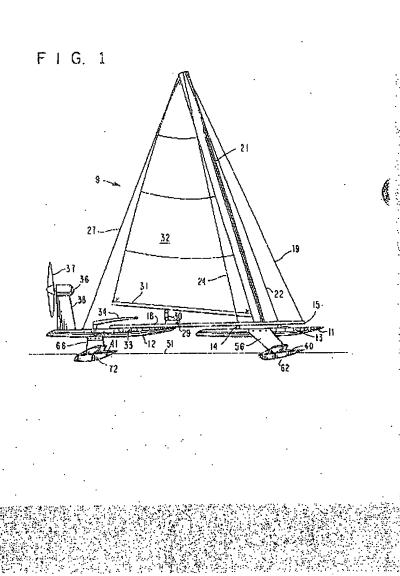
from Figures 4, 5, 6, and 17, enlarged but of identical foil shape, and morely having a weight added to the fore foll sections, performed repetitionally with a surprisingly long glide path, planing or gliding through air, supporting the inherent versatility of the disclosed structures of this invention to plane on or fly through a fluid preferably either water or air. This fore foil stabilized hydroplaning hydrofoil/airfoil structure in the spirit of flight is shown gliding in

In the claims which follow, reference to certain rigures of the drawlings is for the purpose of ease of understanding and not by way of limitation.

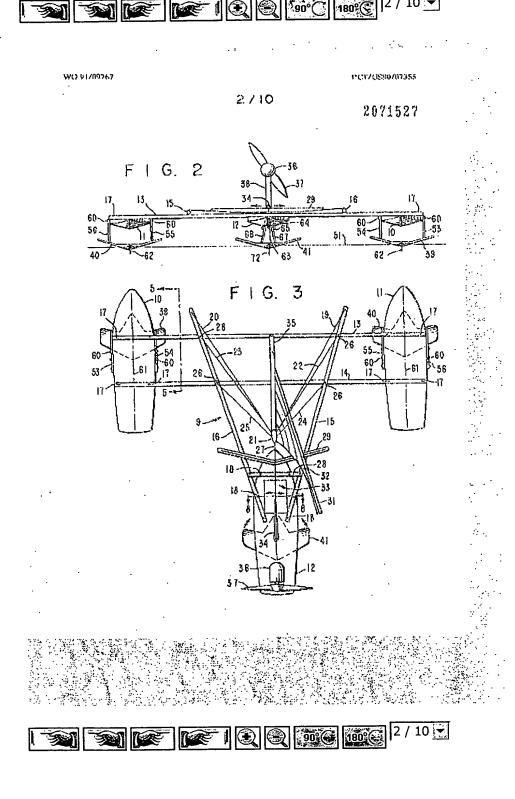


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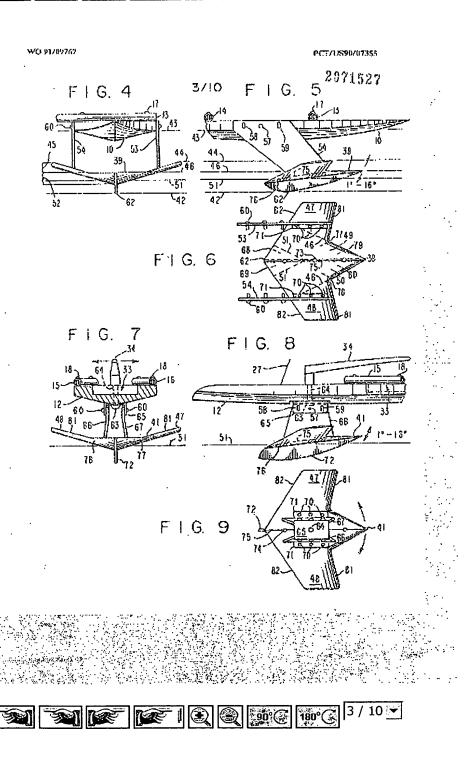


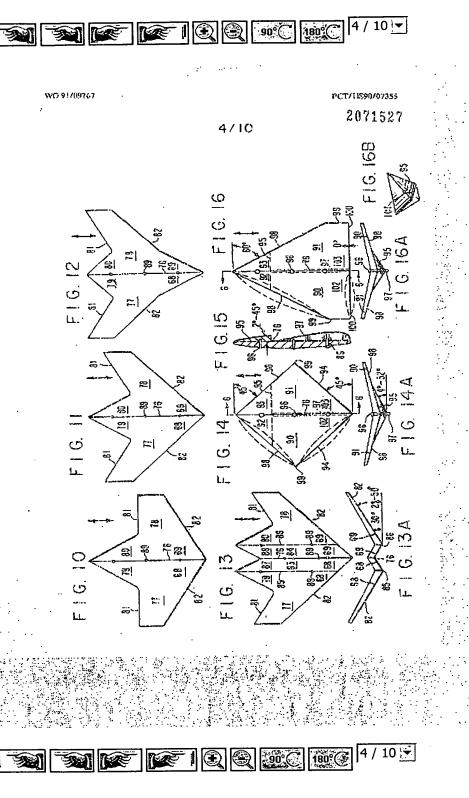


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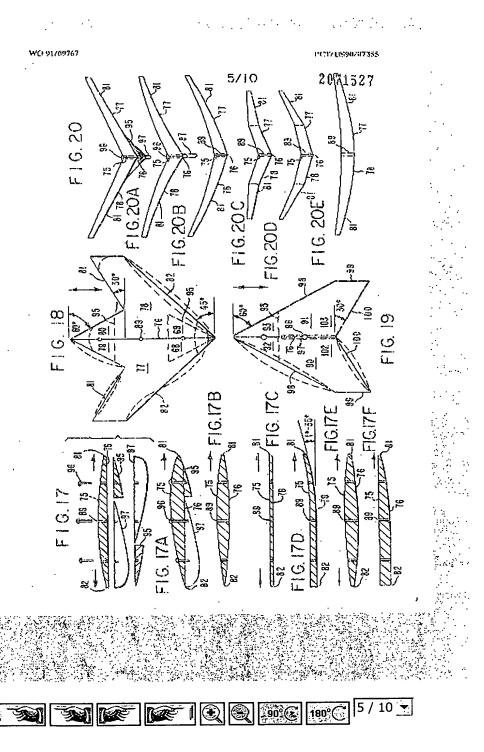






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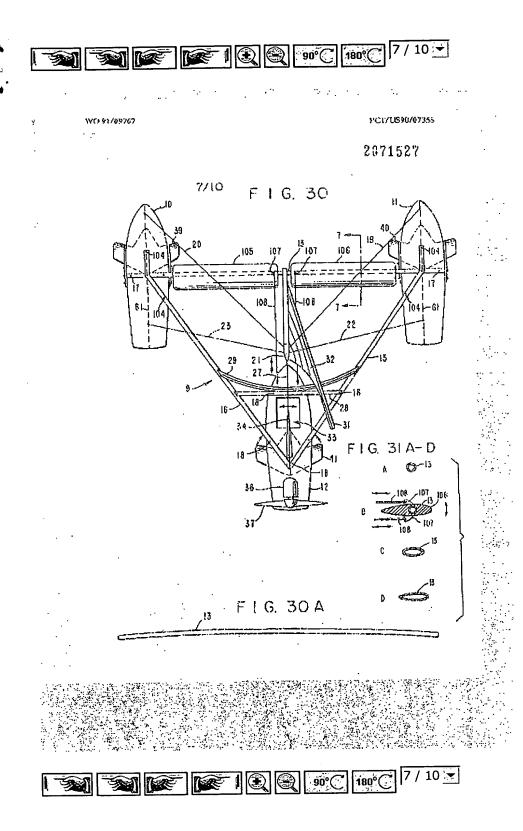






WO 91/09767 PC17US90/07355 2071527 6/10 FIG. 22 FIG. 21 FIG. 23 16 BO 빈FIG. 24 F1G.25 FIG. 26 FIG. 28 FIG. 27

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